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ABSTRACT

There is consensus in the United States that schools are not succeeding. This paper presents recent research in mathematics, science, language arts, social studies, and the arts to discuss ways in which to improve instruction and learning in these areas. Featured topics include cooperative learning, problem solving, use of technology, whole language, constructivism, and standards. (Contains 64 references.) (ASK)

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Recent Research in Math, Science, Language Arts, Social Studies and the Arts

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Washington Institute Foundation

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There is apparent consensus in the United States that our schools are not succeeding. Evidence for this opinion is given by the dismal showing of American students in recent international academic competitions, especially in mathematics and science. These were competitions which most Asian countries did not deign to enter, having walked away with all of the top honors in the previous ones.

Many efforts have been made over the years to solve this problem by fixing the schools. The newest idea is to impose national standards unifying what students are expected to know at what grade level. With the imminence of these standards, which imply achievement, my logic suggested that educational researchers would be concerned with innovations and techniques that would lead to higher grades and test scores. However, using the word "achievement" as a descriptor led to a paltry few studies, most of them in math and science.

Research on the teaching of problem-solving strategies, for example indicated that it neither enhanced nor diminished computational skills, but only that it improved problem-solving abilities (Fennema, Carpenter, Franke, Levi, Jacobs & Empson, 1996; Hiebert, Carpenter, Fennema, Fuson, Human, Murray, Olivier & Wearne, 1996; Kallam & Kallam, 1996; Mastin, 1996; Rudnitsky, Etheredge, Freeman & Gilbert, 1995; Wilborn, 1994; Wood & Sellers, 1996). Technology got mixed reviews. One study (DeVaney, 1996a) found significant negative associations with computation and geometry achievement for the frequent use of computers and using computers for drill and practice. Another (Clariana, 1996) studied the effects of

adding a computer-based integrated learning system (ILS) to traditional third-grade mathematics instruction and found that it made only a small difference in computation skills, but on the Stanford Achievement test the ILS proved to be particularly effective for delivering mathematics concept and application instruction. On the other hand, computer-assisted instruction in addition to regular classroom instruction produced statistically significant gains for at-risk students in the state of New Jersey (Schalago-Schirm, 1995). In other studies, animated graphics in computer-based instruction produced higher scores on a tenth-grade math lesson than did still graphics and text alone (Poohkay & Szabo, 1995) and redundant audio in computer-based instruction reduced the time required to complete practice questions Rehaag & Szabo, 1995). Another factor leading to success in mathematics and science was the choice of courses (Hoffer, Rasinski & Moore, 1995; Rock & Pollack, 1995). The students who took more courses and more advanced courses consistently showed greater gains on test items than those who took fewer, more regular courses.

By using the technique of cooperative learning where students form small groups to work together on problems or projects, many teachers believe they are contributing to academic achievement. Most of the research corroborated that belief for mathematics (Brush, 1996; Jacobs, Watson & Sutton, 1996; Lapointe, Mead & Askew, 1992; Nichols & Hall, 1995), although data from the International Assessment of Educational Programs and the Second International Mathematics Study indicated that teacher presentations to the whole group were more effective.

Another mode of grouping, based on ability, seemed to be more effective for students of middle and upper ability levels than for those of lower abilities (Bode, 1996; Fuligni, Eccles & Barber, 1995; Gregg, 1995).

In language arts, the reading and writing scores of nine- , thirteen- , and seventeen-year-olds remained virtually constant from 1971 to 1992. That would not be discouraging, except that the level where the scores remained was abysmally low, with 40% of fourth-graders, 30% of eighth-graders, and 25% of high school seniors below basic proficiency in reading in 1994. In 1998, the figures improved slightly, to 38% of fourth-graders, 26% of eighth-graders, and 23% of twelfth-graders unable to read at a basic level. The 1990 NAEP (National Assessment of Educational Programs) assessment of the writing proficiency of eleventh-graders showed inadequate skills in persuasive writing on the part of 68 to 79% of the papers rated, and 31 to 80% inadequate skills in informative writing.

Most researchers (Chall, 1996; Coulson, 1996; Davis, 1996; Eldredge & Baird, 1996) placed the blame for that failure squarely on the shoulders of the whole language movement which stresses the immersion in literature over the learning of structure for beginning readers and writers. Whole language advocates argue that children do not need to be taught to sound out words in order to speak, and therefore, they do not need to be taught to read by breaking words into sound groups. They also believe that it is important for children to write without correction so that their creative growth is not stunted. California, which had adopted whole language

statewide, abandoned it at the end of 1998, returning to the phonics approach of sounding out words and memorizing spelling.

Looking at young adolescents in all subject areas, one study (Nystrand, 1997) found that disengagement, including off-task behavior and failure to complete homework, adversely affected achievement while dialogically organized instruction including discussion, authentic questions, uptake, and high-level teacher evaluation, had a strong positive effect on achievement. Other factors studied which had effects on achievement were: 1) expository writing which promoted the learning of content (Newell, 1984; Newell & Winograd, 1989; Newell & Winograd, 1995); and 2) a supportive home environment with adequate learning resources (Fejgin, 1995), which remains unequaled in its contribution to academic success.

In social studies there were woefully few studies which pertained to achievement, although several (Barton, 1997; Levstik & Barton, 1996; Mecum, 1995) examined attitudes towards the history standards that were produced in 1994. Three researchers (Lotan, Cohen & Holthuis, 1994; Reuman & MacIver, 1994; Rothenberg, McDermott & Martin, 1997) did find that cooperative learning had positive effects on achievement, but all the rest of the studies dealt with the more amorphous areas of motivation and critical thinking.

Curiously, the most emphatic research on the correlation of subject and academic success was found in the arts where one study (Bezruczko, 1997) pointed to art-trained children as surpassing their peers in reading. And that concludes the

extent of the material I found which related to achievement, despite the interest in that area expressed in the media and presupposed by the setting of standards.

The vast majority of the research that has been done recently has dealt with perceptions of students and teachers and reflects the prevailing emphasis on constructivism, described negatively by Paul Cobb in 1996 as follows:

> As a theory, constructivism is often reduced to the mantra-like slogan that "students construct their own knowledge."...the characterization of learning as individual construction is frequently treated as a conclusively proven fact that is beyond justification....Pedagogies derived from constructivist theory frequently involve a collection of questionable claims that sanctify the student at the expense of mathematical and scientific ways of knowing.

Expressing the opposite opinion, a spokesman for the National Center for Science Teaching and Learning, and an outspoken advocate of constructivism, Robert Donmoyer, had this to say in 1992:

> ...educational practice should not be built around predetermined student learning outcomes, no matter what conception of learning the predetermined outcomes reflect. This position suggests that rather than attempting to control students, teachers should engage in dialogue with students, and rather than transmitting a predefined curriculum to students, teachers should work with students to construct jointly the curriculum for the class.

Three recent empirical studies in science (Grote, 1995; Kyle, Wolf, Bonnstetter & Gadsden, 1989; Yager, 1995) showed moderate success for constructivist methods, especially for females and low average middle school students. Other research dealt with learning theory, including the learning cycle and stage theory, professional development for teachers, and equity of access to science and mathematics learning on the part of women and minorities.

In language arts, the defenders of whole language cite the "research base" which brought it about. However, my investigation, using the descriptor "research report," did not uncover a single empirical study to support whole language concepts. Instead, there were surveys of teachers' and students' perceptions, observations and vignettes of classroom activities, and the following reasons for not teaching Dickens or Shakespeare, written by an English teacher and published in the English Journal:

> Reading autobiographies are *(sic)* a very effective way to evaluate your effect on your students' development as readers....Honestly, teachers should realize that students are more willing to read books that are of some interest to them and besides books are full of knowledge. Students learn more from things they understand and want to read rather then *(sic)* when they are being forced to read something of no interest to them. (Cope, 1997, p. 23)

Researchers in social studies were concerned with the historical thinking of children (Barton, 1997; Brophy & VanSledright, 1995; Seixas, 1994; Stahl, 1995; Wade,1994), the qualities and deficiencies of textbooks (Kincade & Pruitt, 1996;

Romanowski, 1995; Wade & Everett, 1994), the effects of inschool TV news programs (Anderman& Johnston, 1994; Johnston, Brezinski & Anderman, 1994; Marlow & Inman, 1997; Nasstrom & Gierok, 1996), team teaching (Alspaugh & Harting, 1997), the use of computers (Berson, 1996), motivation, techniques for teaching students with learning disabilities, the value of citizenship education (Anderson, Avery, Pederson, Smith & Sullivan, 1997; VanSledright & Grant, 1994), and the history of the subject itself (Field, 1994; Whelan, 1994). There was also considerable interest in the authors and their studies cited in the 1991 Handbook of Research in Social Studies Teaching and Learning as compared to the newer research methodologies and of multicultural and feminist research which dominate the journal Theory and Research in Social Education.

And finally in the arts, many of the articles argued, sometimes passionately, for the inclusion of art, music, dance, and theatre in the core curriculum. Others concentrated on the difficulty of measuring student progress and the attributes that constitute talent as well as the factors which affect creativity (Etemad, 1994; Hurley & Eisan, 1997; Ward, 1994; Willoughby, Feifs, Baenen & Grimes, 1995).

To conclude as I began, the body of research that I examined in math, science, language arts, social studies and the arts did not overly concern itself with school success as I had expected considering the imminent arrival of national standards. Instead, it seemed to focus on those ephemeral areas of attitudes and perceptions that promote the contentment of teachers and students in their separate and overlapping

domains. Although this is the direction that both schooling and research have taken recently, it is my opinion that they would be well served to concentrate more deeply on academic excellence and achievement.

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